Diode Laser Absorption Spectroscopy for Process Control — Sensor System Design Methodology*

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In support of the Lawrence Livermore National Laboratory's Atomic Vapor Laser Isotope Separation (AVLIS) program, a laser absorption spectroscopy (LAS) system has been developed for process control. LAS has proven itself to be an accurate and reliable method to monitor both density and composition. The success of this system has prompted us to apply this approach to other electron beam vaporization processes. In this paper the important features and components of an industrial laser absorption spectroscopy diagnostic are described. Application of this approach to other vaporization processes requires careful selection of the species and transitions to be monitored. The relative vapor pressure, hyperfine structure, isotopic frequency shifts, and electronic temperature all effect the selection of a particular transition. In this paper we describe the methodology for choosing the optimal transition or transitions. Coevaporation of an alloy with disparate vapor pressures is used to illustrate the methodology. In a related paper T.M. Anklam et al describe the application of this diagnostic to monitoring and controlling composition in a physical vapor deposition process of industrial interest.